

THE INSTITUTION OF PRODUCTION ENGINEERS

PROCEEDINGS.—SESSION 1925-26

*The Official Journal of the Institution of Production Engineers
Published Monthly.*

Contributions from members on matters of general interest are invited, and if suitable will be paid for at the rate of 10s. 6d. per page. Articles may take the form of descriptions of new plant or tools, interesting workshop methods and production problems, or shop organisation systems. All communications, other than those relating to advertisements, should be addressed to the Hon. Editor, Mr. E. D. Ball, 20, Lushington Road, Harlesden, N.W.10.

VOL. V. No. 6.

APRIL-MAY, 1926

(PRICE TO NON-MEMBERS) 1/- NET

EDITORIAL.

AT the last Council Meeting, held on May 29th, proposals for the registration of Engineers were considered. This is a most important matter, of vital interest to every member of the Institution, as well as to other Institutions. As things are at present, the title "Engineer" conveys nothing. It is used by all and sundry, including the man who works a hacksaw in the bar stores. If, however, engineers were given their proper professional status, such individuals could lay no more claim to the title than a curbstone pill merchant to the title of a registered medical practitioner.

The terms of a Bill to be introduced in Parliament have been drafted by the Society of Technical Engineers. This body exists primarily for the elevation of the status of the man who performs managerial functions, so that it is quite fitting that they should have taken the initial step in the matter. At the same time, they fully appreciate that the successful passing of the Bill would call for the support of other institutions, and schemes are now on foot to promote effective collaboration between the various bodies concerned. Meanwhile, every member can do his part to promote the measure by ventilating it as much as possible, as propaganda will be needed quite as much as direct methods. Members are referred to the President's remarks on this subject, published in the December issue of the *Journal*.

A SIMPLE WORKS SYSTEM.

By J. T. Kenworthy (Member).

WE, as production engineers, are called upon not only to determine by what manner of operations a component shall be machined, or a number of components assembled, and the nature of the tools required for that purpose, but also to find a suitable means of issuing and recording the progress of that component or number of components to the best advantage.

Most of you would probably disagree with me if I claimed that the progress system was more important than the actual planning and jiggling of a component, yet I am sometimes persuaded to think that it is so. It is, however, of the utmost importance, and its pre-eminence in the minds of the executives of some industrial organisations is shown by the elaborate organisation entailed for this purpose. It is my firm opinion that a number of systems in use are too elaborate and too cumbersome to be worked satisfactorily and efficiently, and have been built up by some individual who has a love of system rather than a desire for simplicity. On the other hand, there is the system which is built up round an individual (particularly in the smaller shops) which operates quite well whilst the individual can control it, but, as it grows beyond his capacity or when he is absent, falls to pieces.

In the course of this paper I do not wish to infer that any one system can be universally adopted in detail, as the elements which determine its composition are of a variable character, but the principle of all such systems is the same.

The general requirements of a system are: To issue for machining the components necessary for a particular requirement, progress these components through the shops to the final assembly, and establish the means of recording the labour costs against each item in such a manner that the individual cost of each item and also the total cost can be ascertained.

The system I propose to describe to you is one which is in operation in a firm employing about 400 to 500 workmen and manufacturing commercial vehicles. Owing to the alliance of the works system with other departments, it will be necessary to describe in some detail some part of the system of these departments in order to establish the connecting link between the works and other departments.

When the design of a chassis is completed the whole of the parts required for the erection of the chassis are scheduled. This schedule is split up into unit sections, and each unit section is

given a number and a letter. The number is at all times constant and refers to one particular unit of the chassis only. The letter denotes the particular type of unit when more than one design is in existence.

A typical schedule sheet is shown in Fig. 1. These schedule sheets form the basis of the whole of the works system. On completion they are issued to the purchase, progress, planning, and rate-fixing departments and tool room drawing office. The planning department determines what components are to be machined, and marks accordingly in the column for that purpose whether rough, finished, or partly finished material is to be bought.

The purchase department and the progress department then use these schedule sheets, the one for the purpose of buying, and the other for the purpose of manufacturing the required number of units in accordance with the instructions of the management. For the guidance of the purchasing department, suitable maximum and minimum stock figures are fixed for all raw material in the form of castings and stampings and for components bought finished. Suitable minimum stock figures are also fixed for bar materials and sundries such as bolts, nuts, split pins, etc., from an analysis of the complete schedule. The records department then issues a slip to the purchasing department when the minimum figure is reached, and this authorises the purchasing department to buy, replenishing the maximum stock. The maximum and minimum stock figures are determined after due consideration of the time which must be allowed for the execution of an order in conjunction with the probable quantities required per month.

The progress department reviews the position monthly, and, in accordance with the instructions of the management, issues to the machine shops the requisite numbers of components for machining.

This manufacturing programme is ahead of chassis requirements, and instructions in this respect are received at a later period.

Each component is given an index figure 1, 2, or 3, in accordance with the length of time which it takes on an average to go through the shops, and all large components and those requiring a large number of operations are issued about two weeks before the bulk of the material. The average component comes next about one week later, and the smaller components, those with only a few operations, finally.

The sequence of operations is decided by the planning department on receipt of drawings from the drawing office. These are circulated to the progress and rate-fixing departments and tool room drawing office and suitably recorded, as will be shown later. A copy of the master operation card, as used by the progress department, is shown in fig. 2. This card is referred to when any issue is made to the shops for the sequence of operations.

T.S.M., Form No. 14.

MODIFIED BY MODIFICATION SCHEDULE No. SECTION 13B. SHEET 1. (1 SHEET) ORDER NO. 13B

TYPE..... SCHEDULE FOR FAN GEAR (SHORT RADIATOR) FORWARD STEERING.

DEPT..... DATE DATE REQUIRED..... No. OFF CHASSIS NOS.

PART No.	NAME OF PART.	NO. OFF PER SECTION	MATERIAL PER PART.	TOTAL No. OFF.	TOTAL QUANTITY OF MATERIAL.	MATERIAL OF ORDER NO.	R OR F.	JOB. No.
A0697E	Fan Blade.	4	Aluminium Stamping.				R	
	$\frac{1}{8}$ " \times $\frac{1}{4}$ " Rivets (Snap Head)	16	Aluminium.				F	
C0961E	Fan Bracket.	1	M.I. Casting.				R	
	$\frac{1}{4}$ " Whit. Bolt, $1\frac{1}{4}$ " long, sec. $\frac{1}{2}$ "	2	M. S.				F	
	$\frac{1}{8}$ " Whit. Plain Nut.	2	M. S.				F	
	$\frac{1}{4}$ " Grover Washer.	2	S. S.				F	
C0207E	Fan Centre.	1	Aluminium Casting.				R	

	When damper is fitted i.e. Unit Sec. 107A Fan Pulley (Driven) Whittle Belt will be 40 Links	1	M. S. Stamping. S.21.					R		
B0297E	Fan Pulley (Driven)									
	$\frac{3}{4}$ " Whit. Stud, $1\frac{1}{4}$ " long, acd. $\frac{3}{4}$ " & $\frac{3}{8}$ "	4	M. S.					F		
	$\frac{3}{4}$ " Whit. Hex. Nut.	4	M. S.					F		
	$\frac{3}{4}$ " Grover Washer.	4	S. S.					F		
	$\frac{3}{4}$ " Whittle Belt, 4' 0" long.	1	Leather.					F		
B0238E	Fan Spindle.	1	$11\frac{1}{4}$ " of 2" dia. Brt. 45/50 Ton Carb. Steel. S.26.					R		
	$\frac{3}{4}$ " Whit. Slotted Nut.	1	M. S.					F		
	$\frac{3}{4}$ " Washer.	1	M. S.					F		
	$\frac{1}{4}$ " \times $1\frac{1}{4}$ " Split Pin.	1	Steel.					F		
	No. 6 Rotherham Lubricator, $\frac{1}{4}$ " Whit. Gas.	1	Brass.					F		
A0182E	M. S.9 Hoffmann Ball Race. Fan Spindle Ball Race Dust Cover.	2 1	Brass Spinning.					F F		
A0600E	Fan Spindle Distance Piece.	1	$1\frac{1}{2}$ " of $1\frac{1}{8}$ " dia. Brt. M. S. Bar. S.38.					R		
	Hoffmann W $1\frac{1}{4}$ " Thrust Washer.	1						F		

Fig. 1.—A typical schedule sheet. (Issued as a blue print.)

Issuing Raw Material.

We now come to the issuing of raw material for manufacture. It is necessary that some identification be given to each batch issued for costing purposes. The method adopted is to use the part number of the component in conjunction with a stroke number. This method has enormous advantages, chief amongst which is the

T.S.M. Ltd. Form No. 120									
OPERATION CARD. Part No. <i>00.52698</i>									
PROGRESS MASTER COPY.									
Description <i>Brass case Vent Flange.</i>									
Type <i>A. 39.</i> Date <i>10. 3. 26</i>									
Opn.	No. of Oper.	OPERATION						No. of Oper.	
<i>E. 19.</i>	<i>1</i>	<i>Drill Flange face</i>						<i>1</i>	
<i>E. 14.</i>	<i>2</i>	<i>Drill surface 2- 7/16 hole</i>						<i>2</i>	
<i>E. 8.</i>	<i>3</i>	<i>Drill 1 1/2" x 3/4" hole</i>						<i>3</i>	
<i>E. 14.</i>	<i>4</i>	<i>Drill 1 1/2" x 3/4" hole</i>						<i>4</i>	
	<i>5</i>							<i>5</i>	
	<i>6</i>							<i>6</i>	
	<i>7</i>							<i>7</i>	
	<i>8</i>							<i>8</i>	
	<i>9</i>							<i>9</i>	

T.S.M. Ltd. Form No. 120									
OPERATION CARD. Part No. <i>00.52698</i>									
PROGRESS MASTER COPY.									
Description <i>Brass case Vent Flange with Tube, Cap & Stud</i>									
Type <i>A. 39.</i> Date <i>10. 3. 26</i>									
Opn.	No. of Oper.	OPERATION						No. of Oper.	
<i>E. 19.</i>	<i>1</i>	<i>Drill Flange face</i>						<i>1</i>	
<i>E. 14.</i>	<i>2</i>	<i>Drill surface 2- 7/16 hole</i>						<i>2</i>	
<i>E. 8.</i>	<i>3</i>	<i>Drill 1 1/2" x 3/4" hole</i>						<i>3</i>	
<i>E. 14.</i>	<i>4</i>	<i>Drill 1 1/2" x 3/4" hole</i>						<i>4</i>	
<i>C. 19.</i>	<i>5</i>	<i>Fit Tube & Cap.</i>						<i>5</i>	
	<i>6</i>							<i>6</i>	
	<i>7</i>							<i>7</i>	
	<i>8</i>							<i>8</i>	
	<i>9</i>							<i>9</i>	

Fig. 2.

ability to trace at any time when a component was manufactured, who performed a certain operation, and who inspected that operation, as all components are stamped with their part number on completion, and the stroke number denoting the batch in which they are manufactured is also added. All material issued to the shops is recorded on the stores record card, and the use of the

component part number in conjunction with a stroke makes it possible to see at a glance the purpose for which the material was issued without cross-reference to job numbers.

Material is requisitioned from stores, and a shop order (Fig. 3) accompanies the requisition. A daily return is made from stores to the progress department of all material issued, which enables the

[illegible]

Figs. 3 and 5.

latter department to urge jobs not issued or chase the purchase department if material is not available.

The shop order accompanies each batch of components to the shops throughout all operations, and finally goes with the finished components to stores. This originates in the progress department, and simultaneously a production order is made out and is kept in the progress department for reference and for recording the progress of each batch of components until the batch is cleared (Fig. 4). The heading of the production order and the shop order are somewhat similar. At the extreme top of the production order, however,

will be seen twenty spaces, a number equal to the number of operations it is possible to have on the production order or the shop order. These spaces are utilised as a visibility scheme for the purpose of chasing, as will be seen later.

T.M. Ltd. Form No. 20									
PRODUCTION ORDER									
M.O. No. 2906		Date 8.3.26		JOB No.					
Quantity 50		Part No. 065269 1/2		Type 3-30					
Issue No.		Description As ordered. Four 4 Gauge							
Time No.		Material							
Dept.	Op. No.	OPERATION	Chk. Cost No.	Pr. D.V.	Plant.	V.A. Report No.	Own Stamp	Maker's Stamp	Date
E19	1	Drill 4 Gauge. Yacc.	13659	P.	50.	-	-	-	10.3.26
E14	2	Drill 4 Gauge 2-1/2 Lbs.	16245	P.	50	-	-	-	10.3.26
E8	3	Tap 1/2" dia 1 drill 4 Gauge	18636	P.	50	-	-	-	14.3.26
E14	4	Tap 4 Gauge 4 Gauge							
	5								
	6								
	7								
	8								
	9								
	10								
	11								
	12								
	13								
	14								
	15								
	16								
	17								
	18								
	19								
	20								
Passed into Store or Transferred to Assembly.		Quantity	Transfer No.	Date	Quantity	Transfer No.	Date	When Issue is completed this Form is sent to Cost Dept.	

Fig. 4.

As already stated, the position is reviewed monthly, or, to be more precise, every four weeks, and for this purpose the year is split up into thirteen four-weekly periods. The shops orders are

issued in four colours, one colour being used for each period, and after each of the colours has been used in turn the same sequence is again followed. Whilst it was desirable to obtain thirteen different colours to cover the whole year, it was necessary to compromise with four, owing to the difficulty of obtaining satisfactory cards with a reasonable distinction in colour. A list of the periods covered by each colour is issued to each foreman, and his object is to complete all operations by the end of the period denoted by the colour. This acts as a visibility scheme in the machine shop and considerably reduces the amount of chasing necessary. On the reverse side of the shop order are written the sequence of operations and the department in which each operation is to be performed (Fig. 5). Space is also allowed for the time and date on which the operator commences the job. This is filled in by the foreman and is an authorisation to the clock clerk to clock the operator on to a particular operation. When the operation is finished the clock card is made up and the number of hours recorded. This information is also transferred to a cost sheet by the clock clerk, which sheet is forwarded to the works office weekly and represents a weekly record of the time spent on any job. The clock card is then sent to the view room to await the job, which is accompanied by the shop order. The quantity accepted or rejected is filled in by the inspection department. After the component has been inspected for that particular operation the clock card (Fig. 6) is signed up by the inspector and placed in a box from which the cards are collected hourly by the progress department. The information contained on the clock card is then transferred to the production order. Reference to this card at once shows the position of a batch of components in the shops and which operation is in progress.

It will be desirable at this point to explain the use of the spaces shown at the head of the production order. Immediately a shop order is issued to the shops with its raw material the production order is filled. The production order is not coloured, but is filed in accordance with the colour of the shop order it represents. Thus, by the time the whole of the monthly programme is issued a large number of cards are filed representing jobs in progress for a particular period. As too much reliability cannot be placed on components with a large number of operations being completed automatically by virtue of the shop order colour scheme, it is desirable to have some simple system of reference to jobs which are lagging. For this purpose a system of signals attached to the production orders has been instituted. Whatever the number of operations may be on the particular job, this sequence of numbers is written in the spaces provided, always finishing at the right-hand side, and a small signal, as shown, is attached to the space representing the number of the operation which is in progress. As each opera-

tion is cleared, the signal is moved along one space to the right, and when the component is on its last operation the signal is on

Oper. No. <i>18634</i> No. 18634 Oper. No. <i>3</i> OPERATION CLOCK CARD.			
IN.	OUT.	TOTAL	
9.25 W 10 MR	3.30 E 10 MR	5	
HOLD HERE Let Go Before Stamping. THIS SIDE TOWARDS YOU. DON'T USE FORCE. Keep this Card flat. See that it goes to the bottom of the slot when recording time.			
A.M.—Indicated by index letter upright. P.M.—Indicated by index letter sideways.		TOTAL HOURS 5.	
T & M Ltd. Form No 4			
M.O. No. <i>2906</i> P.O. No. <i>18046</i> Name of Part. <i>Blank case. Part. Long</i> Quantity <i>50</i> Workman's No. <i>936</i> Machine		Part No. <i>0052698/2</i> Type <i>P. 39</i> Name of Part. <i>Blank case. Part. Long</i> Quantity <i>50</i> Workman's No. <i>936</i> Machine	
Setting up Time <i>1 1/2 Ls.</i>		Quantity <i>50.</i> Bonus Time Allowed <i>8 Mins.</i>	
No. of Hrs. Bonus <i>1 1/2</i>		Value of Hrs. Bonus <i>4 1/2</i>	
No. of Hrs. allowed <i>6 1/2</i>		Value of Hrs. allowed <i>1 1/2</i>	
No. of Hrs. taken <i>5</i>		Value of Hrs. taken <i>1 1/2</i>	
No. of Hrs. Bonus <i>1 1/2</i>		Value of Hrs. Bonus <i>4 1/2</i>	
% Bonus Earned <i>35%</i>		Checked by	
RECTIFICATIONS.			
Setting up Time <i>1 1/2 Ls.</i>		Quantity <i>50.</i> Bonus Time Allowed <i>8 Mins.</i>	
Actual time allowed <i>6 1/2 Mins.</i>		Value of Hrs. allowed <i>1 1/2</i>	
No. of Hrs. taken <i>5</i>		Value of Hrs. taken <i>1 1/2</i>	
No. of Hrs. Bonus <i>1 1/2</i>		Value of Hrs. Bonus <i>4 1/2</i>	
Part No. <i>0052698/2</i>		Job No. <i>18634</i>	
Quantity <i>50.</i>		Order No. <i>18634</i>	

Fig. 6.

the extreme right. It can therefore be seen at a glance which jobs have the most operations outstanding, and these can be chosen by the chaser as requiring the most urging. This constitutes a visibility scheme of the utmost simplicity. Items which require urging are transferred to a special urging sheet, which has twenty spaces printed alongside each item, and the department in which each operation is to be carried out is entered in the spaces provided, finishing in each case at the right-hand side. It is then the object of the chaser to clear the outstanding operations on the extreme left of this sheet, giving these preference over all others. As each batch is completed the destination is recorded in the space provided at the bottom of the reverse side of the production order. Those sent to stores are accompanied by a form styled "J," which is issued by the progress department, the quantity, date, and number of the form being recorded, whilst those issued to assembly are accompanied by a "stock transfer" form styled "ST," this also emanating from the progress department. The production order is then forwarded to the works office. A permanent record of the completion and the destination of each batch is kept by the progress department on a progress quantity card (fig. 7). As each batch is taken out, the job number and the quantity issued, and the colour of the shop order on which they are taken out, are recorded on this card. On this card is also kept a record of any scrap which may occur, and for reference the number of the inspection report dealing with the scrap is entered. Unless the amount of scrap is great it is covered by the next issue.

Inspection.

I have already referred to the manner in which the inspection department signs the clock card for work which passes that department. This is the only clerical work involved with the exception of dealing with scrap. All scrap, whatever the reason, is recorded on an inspection report. These reports are issued in duplicate in book form and numbered. The report number is entered on the clock card and the shop order, and, as previously mentioned, these numbers are transferred to the production order and quantity card, this ensuring at all time a complete reference should an investigation be necessary. The chief inspector then deals with the scrap and notifies the person responsible if due to machining, or takes the matter up with the supplier if due to faulty material.

Although quite apart from the subject of this paper, I should like to make mention here of an innovation which I consider has been instrumental in preventing scrap. Apart from the normal inspection of components after each operation, all workmen are requested to have the first of any batch on a new operation checked by viewers specially allocated for this work. It was at first difficult to educate the men to understand that this was in their own

Piecework.

I have already stated that the sequence of operations is forwarded by the planning department to the rate-fixing department. On receipt of these, times are fixed for each operation and recorded

T.O.M. Ltd. Form No. 101.

MASTER OPERATION CARD.

Name of Part: *Front Flange* Part No.: *2052698*
 Type: *A-29* Material: *Aluminium Casting* Date: *10.3.26*
 Est. No. _____

Dept.	No. of Operation	Sequence of Operations	Qty. or Pattern	Machines		Setting up Time	Fixed Rate Time	Production Time	Rate
				Desc.	No.				
E 19	1	<i>Turn Flange face</i>	<i>2.000</i>			<i>1/2</i>	<i>- 4</i>	<i>- 3</i>	<i>10.3.26</i>
E 14	2	<i>Drill 4 pin holes 3/16 dia.</i>	<i>2.000</i>			<i>1/4</i>	<i>- 6</i>	<i>- 4 1/2</i>	<i>10.3.26</i>
E 8	3	<i>Turn 1 1/2 dia. & drill 1/2 dia. hole</i>	<i>2.000</i>			<i>1/2</i>	<i>- 8</i>	<i>- 6</i>	<i>10.3.26</i>
E 14	4	<i>Ramp face 1/2 dia.</i>				<i>1/4</i>	<i>- 12</i>	<i>- 1 1/2</i>	<i>10.3.26</i>
	5								

T.O.M. Ltd. Form No. 101.

MASTER OPERATION CARD.

Name of Part: *Front Flange* Part No.: *2052698*
 Type: *A-29* Material: *Aluminium Casting* Date: *10.3.26*
 Est. No. _____

Dept.	No. of Operation	Sequence of Operations	Qty. or Pattern	Machines		Setting up Time	Fixed Rate Time	Production Time	Rate
				Desc.	No.				
E 19	1	<i>Turn Flange face</i>	<i>2.000</i>			<i>1/2</i>	<i>- 4</i>	<i>- 3</i>	<i>10.3.26</i>
E 14	2	<i>Drill 4 pin holes 3/16 dia.</i>	<i>2.000</i>			<i>1/4</i>	<i>- 6</i>	<i>- 4 1/2</i>	<i>10.3.26</i>
E 8	3	<i>Turn 1 1/2 dia. & drill 1/2 dia. hole</i>	<i>2.000</i>			<i>1/2</i>	<i>- 8</i>	<i>- 6</i>	<i>10.3.26</i>
E 14	4	<i>Ramp face 1/2 dia.</i>				<i>1/4</i>	<i>- 12</i>	<i>- 1 1/2</i>	<i>10.3.26</i>
C 19	5	<i>Fit 1/2 dia. cap.</i>					<i>- 6</i>	<i>- 1 1/2</i>	<i>10.3.26</i>
	6								
	7								

Fig. 8.

on a master operation card (fig. 8). Before the shop orders are issued these cards are forwarded to the rate-fixing department, where the necessary clock cards, with the piecework times allowed entered in the space provided, are made out. The clock card numbers are also entered in the spaces provided on the shop order.

The clock cards are then distributed to the various clock stations serving the respective departments.

Tool Room.

The tool room drawing office, on receipt of their copy of the sequence of operations from the planning department, analyse the jig and tool requirements and put in hand the necessary designs. These are recorded on a suitable operation card (fig. 9), and each

T. & M. Ltd. Form No. 1001		OPERATION CARD.					Part No.
Name of Oper.		T.D.O. COPY					No. 62698
Type		Aluminium Casting					Date 10.3.26
No. of Oper.	Sequence in Operation.	Desk.	By No.	Tool No.	Gauge No.	Remarks.	
1	Drill Hanger for	E 19	Z 50822				
2	Drill on face 2-1/2" hole	E 14	Z 50822				
3	Drill 1/2" hole	E 8	Z 50824		X 503	Also used on 121592 etc.	
4	Drill face 1/2" hole	E 14		Y 2389			
5							
6							
7							
8							
9							
10							

Fig. 9.

jig, tool, or gauge is given a number. The location of each tool is then entered on to a location card, a master copy of which is filed in the tool drawing office. One card is used for each component and the full sequence of operations recorded, and the whole of the tools for each operation shown with their bin location and the particular stores in which they are held. The operator can, therefore, on demand obtain all the available tools by reference to the part number of the component and the number of the operation on which he is engaged. Separate cards are used for recording standard tools, gauges, etc.

Assembly.

We have thus far dealt with the machining of components only, and we now arrive at the period of assembly. When the number of units in a batch has been determined, a job number is taken out. Job numbers for assembly purposes are split up into batches and a series of 100 numbers reserved for a particular assembly. For example, job numbers for 2,001 to 2,100 will be reserved for main engine assembly, whilst the various engine sub-unit assemblies will have allocated to them batches of numbers following numerically. This is a considerable aid to all those who have to refer to the job numbers, whether it be foremen, store-keepers, or cost-clerks, as they soon become very familiar with the particular sequences.

The material is requisitioned and held in a service stores until required, then being issued to each workman in sets, in the case of large units or main unit assemblies, or in a number of sets in the case of sub-assemblies or small units.

This procedure, perhaps, calls for an explanation, as the transfer of material from one store to another would appear to be unnecessary. When material is issued to the machine shops for manufacture the whole object is to built units rather than to build up stocks. The issuing of this material and the progressing of same are carried out with the object of finishing the machining for a particular assembly. As has been previously stated, the unit assembly occupies the second floor, whilst the machine shops occupy the third and fourth floors, and the main stores are on the ground floor. It is desirable, therefore, to prevent the material which has been machined going to stores for a period only to be reissued at an early date and again transported by lift. The requisitioning of material is timed as far as possible immediately prior to the finish of the machining processes, and is transferred direct to the unit assembly stores, thus saving transportation. The manner in which this is done will be seen later.

For the purposes of requisitioning, the items contained on the schedule are split up into three categories: (1) parts machined in the works, (2) parts bought finished, and (3) sundries. Sections 2 and 3 are all bought finished, but those items contained in section 2 are special parts to which are given part numbers and for which drawings exist, whilst section 3 includes all items such as bolts, nuts, split pins, etc.

Special typed requisitions are used, it being necessary only to fill in the quantities. The advantage of the suffix given to the part number of each component is now seen. All components on any one unit have the same final letter, and all these parts are stored in one section of the stores. The layout of the stores is based on the suffix letters of the components; thus each requisition

A unit assembly order (fig. 11) is issued to the foreman on the commencement of a job. This card is kept in the clock station and a record of the workmen employed on each assembly recorded. Each unit is numbered and this is also recorded on the assembly order.

Chassis Assembly.

Much the same procedure is adopted for the final assembly of the chassis. As this operation naturally follows the unit assembly, however, and as the main stores are on the same floor as that on which the final assembly takes place, the components are issued

T.-S.M. Ltd. Form No. 334. (Revised 19-8-25.)

Date of Release.....

Date of Issue.....

UNIT ASSEMBLY ORDER.

M. Order No. Assembly Order No. Issued to Dep.

Quantity SETS to Drawing No. Schedule

Name of Unit.....Type.....

	No.	Name of Fitter.	Unit No.	Date.	Initial.	S.T. No.	To Job. No.	Viewer's Signature.
1								
2								
3								
4								
25								

This signature denotes work is finished..... | Date closed..... | Costs.....

Fig. 11.

from the main stores, and the units are stock transferred to assembly or issued from stores as the case may be.

The instructions as to the constitution of the particular type of chassis to be built are issued by drawing office on receipt of instructions by sales. These instructions are shown in fig. 12. It will be seen by reference to the assembly sheets shown that each unit is denoted by a number and a letter, thus enabling any particular type of chassis to be built by the combination of the various units.

All chassis are numbered when completed, the numbers being allocated by the sales department, a series of numbers being designated for each type. Units which have already been numbered are recorded along with the chassis number on special sheets

DESCRIPTION.	Section.	Unit.	Wks. Assem.	DESCRIPTION.	Section.	Unit.	Wks. Assem.
BACK AXLE.				Controller	44 A		
Back Axle Case and Tubes	63 B8		A	Controller Lead and Thimbles	60 D		N
Brake Bands	71		B	Control Hand Levers	43 A	Dash	M
Brake Shoes and Linings	72 A		C	Dashboard Fittings	6 E	Dash	M
Differential	69 A	BK.	A	Dashboard, Moulding, Bonnet Rest & Stiffening Piece	5 A		
Spring and Brake Brackets	70 A		A	Distributor and Drive	85		
Spring and Brake Bracket Fittings	74 D		I	Drawbar Coupling	90		
Back Wheels and Brake Drums	75 A						
Back Wheel Fittings	93 A			DYNAMO.			
BONNET AND RADIATOR.				Dynamo Armature Bear'gs & Hous'gs	48 A		
Bonnet Boards	29 A		T	Dynamo Armature Coils Laminations	47 A		
Fan Gear	13 A		EJ	Com. Bag and Fittings	46 A	P.E.D.	
Ignition Wires and Tubes	27 A		T	Dynamo Armature & Com. Fittings	52 A		
Radiator Side Brackets, Tube Block		RA.	E	Dynamo Brush Gear	51 A		
Overflow Pipe and Guards Only	8 A			Dynamo End Covers	49 A		
Radiator Tanks and Standard Fittings	7 A			Dynamo Field Coils, Interpole Coil	50 A		
Brake Pedal and Clutch Operating Gear	79 A		K	Dynamo Yoke and Interpoles	95 E		O
Brake Hand Lever and Bracket	40 E		J	Dynamo Shaft Ends and Fixings			
Brake Operating Gear	42 K		L				
Brake Rods	94 O		X				
Change Speed Gear	41		Z	ENGINE.			
Chassis Fittings	78 H			Camshaft, Bearing, Chain or Gear Wheel	23 E		EE
Clutch Parts	39						

Carburettor, Induction Pipe, etc.	(42) (36)	ENGINE F	EL EB ED EK EC EA EM EL EF EL EN EH ED EK EG	GEAR BOX. First Motion Shaft Fixed Gear Shaft Gear Box Gear Box Fittings Sliding Gear Shaft and Gears Governor Hand Throttle Control	Y											
28 F G	16 A	21 A	22 D	98 D	14 G	3 A	15 B	26 E	18 A	19 J	4 A	25 A	12 A	24 A	17 G	20 A
Connecting Rod	Crankcase	Crankcase Fittings	Crankshaft	Cylinders	Cylinder Covers & Water Pipe Flange	Valve Lifters	Engine Fittings	Magneto & Water Pump Cross Drive	Magneto Base	Oil Filler	Oil Pump	Oil Strainer	Oil Trough Supply Pipes	Pistons	Water Pump	
80	99 C	100 J	10 D	9 J	30 A	67 A	83	32 A	31 B6	33 A	34 A					
FRAME. Engine Sub Frame Exhaust Silencer Exhaust Silencer Pipes and Brackets Frame Brackets Frame Members Front Spring Brackets Rear Spring Brackets Steering Box Supporting Tube and Flange Front Axle, Pivots and Levers Front Spring Front Wheels and Centres Front Wheel Fittings																
						</										

Fig. 12.—Assembly instruction sheet. (Issued as a blue print.)

by the progress department, copies of which are sent to the cost department and the sales department. Engines, dynamos, and motors are tested before assembly in chassis, and records of these tests, together with the records of the final road tests, are sent to the sales department, thus maintaining a complete history of each chassis.

You will have observed that the keynote of this system has been simplicity. Its present constitution has been evolved over a period of time, gradually eliminating all unnecessary and wasteful procedure. It is not yet, perhaps, all that could be desired, but the change has to be gradual whilst the system is in operation, to prevent any dislocation. To obtain the ideal system it would be necessary to have supreme control and commence at the beginning, even to the choosing of a site, the construction of the shops, and the layout of the plant. Too many systems are rendered inefficient or compelled to be elaborate owing to the misconceived ideas of those responsible at some earlier period for the layout of the plant.

The most efficient system can also be rendered ineffective or at least inefficient by the failure of some supplier to adhere to promises for delivery of material. The more self-contained a works is, the more efficient is that works or any part of its organisation likely to be.

I have deliberately refrained from referring to certain provisions which are made for dealing with special circumstances which are likely to, and do, arise. It has been the object in building up this system to attempt to eliminate eventualities rather than to cater for them. The more these eventualities are considered to be unavoidable the more they grow until the system, if it is attempted to cope with them, becomes so unwieldy that its efficiency is retarded, it becomes slow in operation, and, what is perhaps more important, it becomes expensive.

In conclusion, let me again emphasise the desire for simplicity, provided always, of course, that this is not obtained by sacrificing efficiency and progress.

EMPLOYMENT BUREAU.

Members are asked to do all in their power to make the Employment Bureau a useful feature by forwarding particulars of positions likely to be of interest to those who are seeking new situations.

MEMBER, age 35, having held positions as Chief Draughtsman and Designer, Production Engineer and Works Manager, seeks similar position. First-class references as organiser, controller and inventor.

Discussion on Mr. R. H. Hutchinson's Paper entitled "Payment by Results."

MR. BASS, member, said he wished to congratulate Mr. Hutchinson on his most instructive paper and the excellent manner in which he presented the subject. It opened such a wide field that one hardly knew where to start, but it had always struck him as very peculiar that the Americans seemed to have been able to adopt a payment by results system much more satisfactorily than we in England. In general he did not think that American methods were superior to the British, although he thought much of the trouble lay in the fact that the engineering industry was overcrowded with men who were really not good enough to be employed. As Mr. Hutchinson had emphasised rather strongly, this resulted in the good worker limiting his output to the level of his inferiors. If, however, labour of this class was to be handled satisfactorily, the best course would seem to be to plan out the work and make every improvement in the machines and tools so that the men had no excuse for any leakage or loss in production. Machines could be constructed so that the skill of the worker did not enter into the question at all, because the machine did the work, and it was just a matter of obtaining a man to attend to the machine and use ordinary judgment. At present, however, there were lots of little loopholes for leakage and loss of time or inaccurate work.

Another difficult matter to control was the market. It was useless to attempt to induce a man to give a good output and then in about two months time to tell him that there was no more work and that he must stand off. The man naturally thought that he had been doing too much work, and to remedy this it certainly seemed that we must find an outlet for production.

Another important point was to allow a man to earn money while he could. There were still many cases of rate cutting when a man appeared to be making too much money, or even when times were cut down for a legitimate reason, such as alteration in method of manufacture, which was not done sufficiently tactfully.

Much could also be done if the organisation of the shop were carefully looked after so that operators could not turn round and say, "I have to go here for this and there for that," etc. In a good many places he felt certain that the management did not know what a given machine could produce in a day. If they could establish that and base their times on such facts so that

the man had only to keep the machine working, many of these leakages and sources of loss would be avoided.

With regard to the American workman who drives to work in his own motor car, the reason for this was that the man was given every opportunity for making money, and if he wanted to buy a car or a wireless set, it was not a matter for long saving, but just a question of working harder, and he was allowed to do it.

MR. RONALD, member, disputed the statement that the principle of "Payment by Results" had been adopted more satisfactorily in America than in this country, and he would like to ask Mr. Bass what grounds he had for saying that this was so.

MR. BASS said that it was a recognised fact that a large majority of factories in the States were run on the Ford system or a similar kind of system, and without doubt the men were allowed to earn much more money than in England. He assumed that the reason was that in England we had really the old autocratic type of employer, whereas in America employers were of a more democratic type, and they did not mind if a man earned as much as they did as long as they obtained the required output. Further, the Americans found a market for their products because they made them so cheaply that people had to buy them. In England, on the contrary, the practice was to make a few articles and charge the highest possible price, with the result that the market was very restricted.

MR. RONALD said that in Britain straight piecework had been in operation as long as could be traced, whilst the first bonus systems were run almost simultaneously, in this country and in America. Keen controversy existed 25 years ago about these systems, whilst a protracted discussion was carried on in *The American Machinist* some years ago regarding the respective merits of the two most popular rival systems—i.e., Halsey and Rowan—then in vogue. He did not think America had much to teach us so far as systems were concerned. Mr. Bass had stated that they had made wonderful progress there, but one so often heard it stated that everything in America was heavenly, and conversely in Britain, that he, personally, was inclined to treat it as a parrot cry.

A VISITOR remarked that he was very pleased to hear the patriotic sentiments Mr. Ronald expressed. He entirely endorsed such sentiments, and he also agreed that the fact that the American found their market was one of the cruxes of the question. The American was prepared to invest his money in advance to create a market. The Britisher wanted to find his market first before investing his money. That, in his opinion, was one of the difficulties in running bonuses successfully in this country. The trouble had really nothing to do with the bonus system, but

was related to the quantity of work to be done. In America manufacturers go ahead, and by producing large quantities they placed their goods on the market at a price at which they were able to sell them. When one thinks of the trade which was captured by other countries, and the hoards of money lying in the banks, it was a crying shame that people would not use their money and sink it in trying to promote trade for this country.

MR. GARTSIDE, member, said that in his own branch of trade everything they made was special, and it was almost impossible to make use of piecework prices, although in one department they did so, but they had had continuous trouble with their men, and in his opinion all these troubles had been brought about through lack of confidence. The seeds of the trouble were probably sown 30 years ago. There were no rate-fixers in those days, but the men worked on straight piecework, and prices were fixed so as to allow them to make $33\frac{1}{3}$ per cent. All the time the employers were watching seeing that prices were fixed as low as possible, and as one of the men working in the shops he could remember that they were aware of this and were chiefly concerned in stretching the time out as long as possible.

Another thing was that in the old days firms always endeavoured to keep catalogues and price lists away from the workmen, but it would sometimes leak out how much a master was getting for a machine. We used to think what profits the firm were making out of this job, as at that time we did not know much about establishment charges and non-productive costs. Comparing the price that workmen obtained with the price of the finished product, the men thought that they were being "had" all the time, and that was probably another reason why there was not the confidence there should be to-day. Thirty years ago the men certainly had no incentive to turn out the maximum quantity of work, since if a workman earned more than 4d. in the shilling it was taken off. If a man were making more than that it would be the man next to him who would complain. He had always maintained that the British workman to-day was far more frightened of his workmate than of his employer, and only education would dispose of this difficulty.

Much had been generally said concerning American piecework, but there was one important fact that must be taken into account when making comparisons. Was the American any more tired after working ten hours a day than the British workman after his eight hours a day? He did not think there was any difference. If one looked at the statistics with regard to horsepower used per man in America as compared with this country, the figures in America were much higher than here, proving that it was the machines and not the men who did the work. This opened up a very big question, namely, the management of shops

so that a man could work more than one machine. He could remember being in Germany before the war and seeing a man working two lathes on a job, which for a British workman at that time would not have been possible in this country. But the German could do it for 28s. a week, whereas our men were getting 34s. Until we can educate our men to take these facts into account we shall not get much benefit from payment by results.

Speaking of markets he maintained that if Ford had started his factory in England he would not have made a success of it. To begin with, he would have had endless labour trouble, and he would not have had any market to work upon. The Americans had always got their own market upon which they could experiment and then export their goods to the world, but our home market was very small, comparatively speaking. He thought Mr. Hutchinson had dealt with the subject very clearly, and he fully agreed with all he had said in the paper. That was that a proper system must be introduced and the workmen must be educated up to the required point to use it successfully.

Mr. J. W. B. FARMER, associate member, said that the question of policy of the individual firms concerned was the first thing that ought to be known in the fixing of times. His experience was that rate-fixing revealed the policy of the firm in many ways to the worker, and it also showed him how difficult it was to fix rates when a firm were unable to adopt a consistent policy under the present competitive system.

With regard to the fixing of times, in the old days it seemed to him that they must take into account that there was not then any such thing as mass production, or high precision tools, or scientific organisation. In recent days, however, most firms had some sort of up-to-date system which made it more important that the rate-fixer should be given a more prominent place in the organisation. We were all agreed, as production engineers, that pre-planning was a very important matter. It affected every phase of manufacturing in the works. Tool design, the issue of material, the inspection department, and machine operation all came within the range of the rate-fixer and his department, but in many firms there was a lack of co-operation with the rate-fixer in these matters.

The President had referred to the qualifications required by the rate-fixer. In addition to the attributes mentioned, he should also have an enormous amount of tact, which most of us had to acquire by experience. It was also important that, in addition to pre-planning, the rate-fixer should be able to give more definite and fixed particulars. Regarding the question of overhead charges, the worker knew to-day where the overhead

charges were derived from, but he believed that if the pre-planning were sound they would have little cause to know about overhead charges. His experience was that where the harmonious co-operation of the various production departments could be obtained the men were more satisfied, and feeling sure that there would not be any price-cutting they went about it.

Feeds and speeds were also very important, but it was his experience that, however good they might be, they could be surpassed. Related to this question was that of materials. The rate-fixer might fix feeds and speeds, but they were so variable that they were nothing like the standard that should be obtained, and men could often take advantage of that, unknown to the rate-fixing and production departments. Rate-fixing was largely controlled by the material which was being used; also the machine on which the work was being done was another important matter, as well as the condition of the machine. The rate-fixer might give a time which he felt to be just on one machine and find that on another machine of the same make he could not get the same results, irrespective of the skill on the job. This obviously means that the men are at a disadvantage or the time must be changed, which is a very difficult matter in the majority of firms. Unless it is possible to obtain a measure of consistency or uniformity of machines it is necessary to have a rate-fixer on the spot. Many firms have never recognised this point, and a lot of them work from prearranged times on the jigs that are available. If a man is prevented by circumstances over which he has no control from making a job pay, he at once feels that he is being hit, and then suspicion steps in and, following that, lack of output.

Regarding American piecework systems, there are firms in this country working on systems equally as good, in his opinion, as the most successful American systems. There was, however, the trade union question. In many ways the unions regarded payment by results with suspicion, and as the Chairman remarked, this was why it was necessary for the general character of a rate-fixer to be of a very high order. The foreman should have the confidence of the rate-fixer as far as possible. It is inevitable that the foreman should have a leaning towards the workers' side. At the same time foremen should be brought into touch with the rate-fixing department to realise that it is part of their job not only to allocate work to the men, but to see that it is done in a scheduled time. Many foremen seem to think that they are relieved of any responsibility in this direction by the rate-fixing department.

It had been said in connection with selling that in America the market was already in existence. He did not agree. It was his opinion that in America goods were manufactured very cheaply, and where goods could be produced at a low price there

was always a demand for them. The aim should be to obtain the lowest price always by up-to-date methods, increasing and improving those methods so that a consumer could be offered an article cheaper and cheaper still. This does not mean that the worker would have to be cut down by dealing with methods of pre-planning, time study, etc., but a really scientific basis should enable good wages to co-exist with goods at a reasonable price.

On the question of capital there was an entirely different outlook in this country and in America. If we could show British investors that goods could be produced at a price he did not think they would refuse to put their money into the business. One or two firms in this country had already demonstrated that fact. The time was fast coming when the prices of commodities would be considerably less, so much so as to enable us to compete in foreign markets.

MR. E. W. HANCOCK, member, said that he was not very conversant with the subject, but in his opinion the first question was, "What was payment and what were results?" The Chairman had said that the American had foresight. He had a clean, good job throughout; he probably built a new factory, introduced new machinery, brought his knowledge of human nature to bear, organised sports, recreations, saving funds, etc., for the workers, saw that the sanitary arrangements were correct, that his lighting was good, and then he experimented with the job until he was satisfied throughout the works that so many parts could be completed in a week or a day. When he had done that he called for a certain number of men and said, "Here is the job. This is what we want and this is what we are going to do." The men could start on their work if they fall in with the contract. In this country it rather appeared that we were trying to make our bed and at the same time to lie in it, which was a very difficult proposition. It did not give us an opportunity of cutting clear and putting the proposition before the workmen. He was referring now more to the policies of companies than to lesser individuals in the great work of organisation. He thought that where we had a successful organisation in this country, if they commenced with a clear outlook and a clear demand both from the men and a knowledge of the requirements of either the country, the nation, or the world, that was a fair start for any sound-thinking man. If, however, they started a man on one thing and then before a week or a month had elapsed he was pushed over to something else because they did not know what the future held, they could not expect the worker to understand the position. If, however, they made their objects clear before starting, as one or two others in this country had done, we should have a greater opportunity of winning the co-operation of employees.

Mr. FERGUSON, member, regretted he was prevented from attending in time to hear the President read his paper, but he had listened to one or two speakers, but not one of them had mentioned any system of payment by results to indirect producers. He believed, however, he was correct in saying that if we took an average over a number of large engineering establishments we should find that approximately 40 per cent. of the workpeople employed were indirect producers. He thought that if they could obtain some system of payment by results to include the whole factory they would then get whole-hearted feeling amongst the employees and better production. He believed that there were some firms who had systems in operation which would do this.

Another point was the changing of piecework prices once they had been fixed, which had been mentioned by a previous speaker. That was contrary to agreements. There were agreements whereby men of average ability were enabled to earn 33½ per cent. over their base rate, and the price when fixed was unalterable unless the means or method of production were changed. Surely it was the fault of the management for fixing the price too high if this increase was earned without extra output, and it was wrong once the price was fixed to attempt any alteration without taking the men or the representatives of the men into consideration before doing so. If either by discussion or through some of the engineering journals we could open up a line by which we could get information as to cost and method of operating such systems of payment by results to indirect producers as well as direct producers, we should be going a very long way towards the object to be achieved, *i.e.*, a standard system of payment by results for all employees. Take the millwrights, and toolmakers, and the various other sections of the factory, for instance; sometimes these men, when on payment by results, are paid the average bonus or a percentage of the bonus earned by the direct producers. This was wrong, because these men might not be pulling their weight and yet they pick up exactly the same amount as a man who puts in 47 hours a week at piecework speed.

Mr. GORDON ENGLAND said that as a visitor he was surprised that there were so few employers there. He happened to be an employer, and had come to learn something, and thanked the members for teaching him. He would like to make one or two remarks dealing with his own line of thoughts on the question of payment by results. In the first instance he started his engineering career at the age of 15, and the first thing that struck him when he went into the shops, and from what he had heard from the conversation of the men, was the eternal fear of having a rate cut, and that the employer was not going to play a straight

game. He thought that we were now reaping the result of the widespread fear existing on that point. He had never forgotten that one fact. He was a great believer in what the Chairman had said: "Remember that the men are human beings as you are yourself." He believed that was the real key to all industrial management. Unless this fact was fairly fixed in front of one, one could not hope to make a real advance in a country such as ours, because if there were one country where men were men it was Great Britain. He thought we were all proud of that, but it made the men more difficult to handle. It seemed to him that with a mediocre class of man one could do a great deal with them which we could not do with a Britisher, because he would not put up with it; thus we were apt to get a warring spirit instead of a conciliatory spirit. That ought to be borne in mind, and also that our workers did hate an unfair deal.

There was also the question of patriotism. One speaker seemed to take the view that there was too much expression of the view that American methods were better than our own. That was not the point, however. America was a new country, and although some of them had very good ideas, they had really taken existing methods from the Old Country and developed them to their logical conclusion. There was no reason to fear originality in the American, as some of their methods were extremely good British typical methods or were taken from some other European country, and were not necessarily American at all. It was their application and not their originality that we had to fear. We ought to keep that well in mind, and not be afraid, owing to extreme patriotism, of taking up anything good which might appear to emanate from America just because we first heard of it in connection with some American concern.

He was at present in the fortunate position of developing a new firm. He said fortunately because there were naturally a whole lot of preconceived ideas and traditions which did not exist in the case of a new works. They had developed rapidly from quite a small way to a fair number of men in the course of 18 months, and he was frankly very anxious to use what was called the Ford system of payment by result. They had not yet got it into operation but that was what he was planning for, because he foresaw the difficulties in dealing with the work in any other way. With this in view he was pursuing a certain very definite policy with his men. His foremen were practically all of them men who had risen since they came to the firm from bench and machine hands, and he had taken these men entirely into his confidence.

One member had already mentioned during the discussion that in his time the men were absolutely devoid of any knowledge of overhead charges and that an idea had been general in the past that

the master made huge profits, because the men knew nothing of overhead charges. Bearing this in mind, he was taking the men into his confidence, and once a week the overhead charges were laid before them and all other company figures as placed before the board. He found that this was a wonderful help, and that it had the effect of making men more capable of assisting in cutting costs as well as giving them a keen interest in the business. They were now as keen in the prosperity of the business as he was himself, which was an admirable state of affairs. They were able to see what profits were to be made, since he was placing the costs of manufacturing the goods before them and telling the men frankly what they were selling for, and what was still more important, he was giving to his men the price quoted by competitors. That in his experience was the finest thing that could be done. It put the men on their mettle. In fact they said: "We must get down to this; if they can do it we can do it." Following on that line, after pursuing this policy for some time he had put it to his foremen that he wished to introduce some system of payment by results. Now from what he understood of the Ford system it amounted to this. The company paid a wage which they said gave men a chance of living decently and being decent citizens, take an interest in other things than their work, and be a credit to the company they are concerned with; but in return for that wage the company said they must have a definite measure of service, and men who could not give that measure of service must get out of the firm. At first sight this sounded very hard and very unjust. However, he put it to his foremen as to whether they would be willing to introduce such a system amongst their men, and whether they thought the men would stand by it. The following week they returned to the subject, and the foremen were unanimous in saying that they were firmly of the opinion that as soon as the system was put into operation they would get the desired results, and there would be no trouble at all. He made it clear that the system if applied would be applied equally to foremen and to all the office staff and to everybody else, and if they did not adhere to it they would have to go. He merely quoted this as an example, but he had thought that it was of the utmost importance to-day to remember that the men were educated, and that if they were any good at all they had got brains. They could add two and two together to make four. Treat the men as business men and not as machines, and he thought we should get the desired result.

MR. RONALD said he did not understand the Ford system very well, but he gathered that a definite amount of work was required for a definite wage. Was there any reward for extra work, or must a man do only a definite amount, and presuming he could do more was he debarred from so doing?

A VISITOR asked as a point arising out of the question that had just been put whether any way had been found whereby men could be trained to produce the definite measure which was required of them for a particular job. Was there any alternative for doing the work in the particular time or getting out? Could men be trained up to produce the required standard?

MR. GORDON ENGLAND said that as far as he was concerned he was only trying to apply the outline of the system. He intended to vary it according to his own ideas, and one of his ideas was "that no two men were the same." He was a great believer in trying to remember that men are never machines, and whilst no two men could give the same measure of service in any one direction, they might be sized up and valued on every single attribute and find two men of the same value. With this in view they proposed in their scheme to grade their men to the best of their ability, which would depend, of course, largely on the foreman. They would then introduce a diversity of rates to try and cover the different grades and thus obtain a working system, and this principle had, as far as he was aware, worked satisfactorily elsewhere. In actual fact the whole of the output had to be estimated at a certain definite labour figure.

THE CHAIRMAN said at this point, that in his opinion the Ford system was always lacking in this respect. He thought it made no differentiation.

MR. GARTSIDE said that his idea of the Ford system was, that if one started a runway or travelling truck the men were posted in a row, and if one man in that row could not do his job he had to make room for someone else. His time was fixed for him, and he got so much per week for doing that particular job. He could not see how he could do any higher output even if he had the ability to do so.

MR. OAKLEY, member, referred to the payment of bonus to the foremen and staff. He did not think that the engineering profession as a whole had adopted the payment of bonus to the staff like other industries outside of engineering. In one trade that he knew of everyone other than pieceworkers was paid a certain percentage for the quarter yearly turnover above a certain profit. The firm realised that a certain profit was reasonable enough. Depreciation had been taken off and a certain amount of reserve, and the remainder was divided between both pieceworkers and day workers, including foremen and the staff generally. It occurred to him that this was where the engineering trade was lacking, although at the moment it was no doubt due to very bad trade. The sooner employers could get down to one fact and give foremen some incentive to keep the payment by results system going better than it was at present there would be an improvement, and we should make great strides in output.

MR. R. BISHOP, visitor, said that he thought it a great favour to listen to the President's introduction, and he also thought it would be a fine thing for Mr. Hutchinson to go round with his paper and lecture at all the trade union gatherings and employers' federations, and, incidentally, some of the financial people who put the pressure on at times and cause firms to cut prices down. The most difficult thing seemed to be the suspicion which exists between the two authorities to the deal. In England, of course, we had a legacy of suspicion arising from the actions of employers, not only 30 years ago, but 100 years ago, when employers acted rather high-handedly. We still suffered from the results of this. One of the reasons why the American people seemed to be able to go ahead was that they were not faced with this legacy of suspicion. He had been over there for three or four years and had never found any of this friction or suspicion throughout the factories, and a man in the shop was not afraid of the man working on the next bench.

Conditions were also very different in American practice. They had a clean field and a firm labour market before them, whilst they had all the fresh labour from Europe. A large number of the factories concentrated on a winter programme seven months of the year. After that many of the men went back to their farms, or went on the Great Lakes, or they went painting and decorating and working on other jobs which could not be done in the winter time, and then in the winter they flocked back into the factories, and the employers had a nice fresh bunch of workers with all the piecework and rates ready to start on, and they just did all they could and then went out on their farms and settled down.

MR. W. J. BEATLEY, visitor, said that this system of payment was very interesting to him, because several years ago he had a few years in the shops and had now gone to the other side of the engineering industry. He felt sure that there was a certain endeavour in the shops to-day to restrict output on the part of the workers, and he felt bound to say that the inefficient must to a certain extent go to the wall. It was so with the employer who, if he were not efficient, went to the wall very much indeed, but in the case of the employee there seemed to be much greater protection extended to him.

With regard to the Ford system, he started a correspondence with Ford Commercial Motors in January concerning their operating costs in their factory, and he had had certain communications with the Ford Motor Co. about the matter. The question was asked as to how their production method was carried on. Each man was started at a minimum wage of 2s. 6d. per hour at the rate of production for the first six weeks, and this was automatically increased to 3s. an hour, and so on. The

rate of production was, of course, fixed by the unit system of the moving track, so that if a car by any chance got to the end of the track minus a certain fitting it was at once obvious that John Smith up the line had not been going his bit.

Further, in America there was nothing secret about the costs of production and overhead charges, because all income tax returns were published and the whole thing became automatic. Moreover, in discussing the Ford system they had to bear in mind they had far less labour trouble in the Ford factory than in any other factory in Great Britain. This undoubtedly said something for the method of dealing with employees.

Regarding the possibility of reducing the price of an article, there was this to bear in mind, that the less one charged for an article the more people there were who were able to use it. He was really of the opinion that the sole secret of success in solving the majority of our labour troubles laid in the education of the worker.

MR. GARTSIDE said that, since the question of finance in the engineering trade had been mentioned, to get on well in business one had to pay by results. If there were no profits or no dividends there could be no payment of bonus. That is the other side of the question.

Another point that had not been mentioned in comparing America with this country was that the American paid just under £5 income tax per £1,000 salary, whilst the Englishman paid something like £120 per £1,000. That must all come out of the overhead charges before any profits were made, and it was rather galling that we heard such wonderful reports on what could be done in America. That additional money had to be made out of someone before we could show any results at all, and that was why there was not an engineering firm in this country that had any money to lay out at present. They were all working hand to mouth with the wage they paid, and had no money to lay out on new plant. In this country one could go round the shops and see that 50 per cent. of the machinery should be scrapped. He would not compare the shops which had been built since the war. Moreover, firms which had built up a reputation in this country made machines that would never wear out, and they were the people who had got no money to turn round to-day. It was not that the men would not do the work, although there were certainly a great deal of blame attached to them owing to suspicion from one cause or another. The question of paying the non-producing staff had been mentioned, but it could all be reduced to payment by results. This was where mistakes were made, where men had been placed on bonus or output or according to the profits the firm had made. People said with regard to the workman, "Give him an interest in the busi-

ness." Suppose, however, that there were so many shares and that dividends were paid. I think it would be a big firm who employed a thousand men and could afford to pay £100 share to each and show a profit. Suppose, however, that this was done, thus making each man into a shareholder, and that the firm made $2\frac{1}{2}$ per cent. profit. Then after a man had put all his energy into the business, at the end of a year he would receive £2 10s. That would be no encouragement. It did not satisfy the ordinary shareholder for £100, but it was quite another matter in the case of a man who had been working all the year for it. Thus giving a man an interest in the business on these lines was of no use, because it was impossible to give him sufficient interest on the share basis to make him care whether the firm made 5 per cent. or 10 per cent. profit. That was not enough in twelve months; the average workman expected that amount every week.

Mr. BASS asked how the request of the engineers for £1 a week extra would affect the question of payment by results. He was inclined to think that if a satisfactory system of payment by results were introduced there would be no necessity to demand £1 a week more, because it could be earned.

Mr. FERGUSON said that it was possible that the present application for an advance in wages was to a great extent caused through pressure being brought upon the unions by non-productive men such as toolmakers and millwrights, who were unable to increase their earnings by any system of payment by results. In some cases semi-skilled employees working on a payment by results basis were taking away more money than the above workers. In certain cases the trade unions advised their members to restrict their output; there was also considerable restriction of output owing to the selfishness of such sections as, for instance, coppersmiths, who frequently refuse to bend a pipe or a template made by a toolmaker.

With regard to men on certain machine tools, if one attempted to train labourers to work certain machines to enable them to increase their earnings, the trades unions made application for the skilled rate for such operators, despite the fact that the operations do not call for the skill and ability of the skilled mechanic. Every man should have the opportunity of earning as much as he possibly could, and he thought that one of the reasons why there was an application for a 20s. per week advance in wages at the present day was because every man was not allowed to earn as much as he could under a system of payment by results. One could not blame toolmakers, who were super-skilled men, for applying for an increase when they were not allowed to work under a system of payment by results, and when unskilled men were earning more money than they were.

Mr. RONALD said it was common knowledge that toolmakers at any rate were divided on the question of payment by results. In a toolroom under his control on several occasions the toolmakers had been asked to accept the principle of payment by results, and on each occasion they had definitely refused. He had, however, had charge of a shop where toolmakers had accepted a bonus system and worked it for years, and in several other shops he knew of toolmakers had accepted the principle. He thought, therefore, that as far as toolmakers were concerned it was a question for each individual shop to decide for itself.

Mr. HUTCHINSON said that as far as the questions raised concerning America *versus* England were concerned, the matter had been fairly thrashed out in the discussion. There was, however, one point which had not been mentioned at all, and that was that one must realise that there was a great factor in America in climatic conditions which did not exist in this country. Where one found an American firm opening up a works in this country bringing a big staff over here, and after a time one talked to the American who has come over to this country, one soon found that he felt very different here after a day's work to what he did in America. What is more, considerably more than 50 per cent. of them would tell you after they had been here for some years that they were anxious to get back to America, whilst even those who did survive here were all of the opinion that the climatic conditions were not the same over here.

Mr. Gartside had said that he worked in a shop where every job was different, and that it was, therefore, impossible to pay by results. He did not agree. There were several shops in this country (to mention one very big firm, Vickers, Ltd.) where in many sections they were doing constantly changing work. Nevertheless, the foremen, and incidentally every worker in the toolroom, was on premium bonus throughout. Even the swarf wheelers, etc., were paid bonus for the number of tons of swarf they moved for the week.

Mr. Gartside had also mentioned another important point, *i.e.*, that workmen were more frightened of their workmates than of the employer. Unfortunately that was very true. The British workman was a very fine fellow, and if one went to him and said, "I want to go all out on this job and push these parts through," he would go all out, but he would not dare to book his time. He would adopt any subterfuge rather than enter it correctly, because if he did so his life would not be made miserable by the ratefixer or by his employers, but by the men around him. This was one of the things which we must wipe out if England was to retain her place in the world markets.

Mr. Oakley had mentioned another important point, *i.e.*, that the fixing of times reveals the policy of the firm to the worker.

He (Mr. Hutchinson) was afraid this point was not appreciated, otherwise a great deal more care would be taken in the handling of rates and in the selection of the rate-fixer.

Mr. Bass had mentioned the question of pre-planning, saying that he thought it was a good policy not only to plan out but to try out all operations and times before putting the work into the shop. Where there were fairly large quantities of a new product to be dealt with, there was no doubt that this was an excellent system. It enabled a lot of points to be discovered which might cause dissention later on.

With regard to the workers' knowledge of overhead charges, the remark had been made that workers were human beings, and this being so they had a very human outlook. Unfortunately, there seemed at present to be an extraordinary idea being instilled into the minds of the workers, no doubt by the Minority Movement, that the employer was trying to twist the workers. This being so, when the workers got some knowledge of overhead charges, but not a complete knowledge of the factors involved, certain points were likely to strike them as frightful injustices, and they were liable to get distorted views. This would happen unless we could adopt the principle suggested by Mr. Gordon England of taking all our men entirely into our confidence. That policy might be all right in the case of Mr. Gordon England, because he was free to do as he pleased, but most of us were hampered by traditions many years old, and frequently by old directors. If one were to suggest to some of these that the men should be told everything there was to know about overhead charges, etc., they would either die of heart failure on the spot, or one would be looking for another job very quickly. It was, however, the right thing to take the men into one's confidence. He believed that emphatically, but it must be done in such a way that the knowledge grew in the minds of the workers. Correct ideas must be instilled into them bit by bit, which was very difficult, owing to the ramifications of a large business and the means of putting it before the men and expecting them to understand it in its entirety.

Someone had remarked on the stop watch method. He thought this a very bad one, and was of the opinion that it ought to be absolutely debarred. The man who had to resort to this method of fixing times did it simply because he did not know his job. All times should be fixed by a careful study of time factors, and no doubt these could be put together and checked by time study afterwards, but the idea of fixing a rate by the stop watch was quite wrong.

There was another very important point, *i.e.*, the production engineer must work with the object of giving the British investor confidence in our ability to produce at the correct price. If that

happy result could only be achieved there was sufficient money in this country to invest in manufacture, and we could without doubt produce in a manner equal to, if not better than, any country in the world. We could give that application to our own ideas which was at present being given by the Americans, and we should never lose sight of the importance of trying to impress on people that we were working with one idea, showing that cheaper production could be achieved in this country.

Mr. Ferguson had mentioned the question of a system of payment by results to indirect producers. That was a point he had not mentioned in the introduction because he thought it would probably come out in the discussion. Now there were several systems working on the policy of paying proportionate bonuses to foremen, at all events on the bonus earned by the men working under them. To quote Vickers again, the system adopted by them was that the charge hand received the average bonus of the workers under him less a percentage for bad time-keeping. The assistant foreman got a proportion of the bonus, say, 50 per cent., less 20 per cent. for all bad timekeeping. So it went on up the scale to the head foreman. It was important to bear in mind that at Vickers the charge hand was the equivalent to what in the Midlands and the South of England is termed a foreman, whilst above him there was the assistant foreman, and the next man was the head foreman, who would rank as a shop superintendent. Probably the best system which he had come across for the payment of bonus to the indirect producing staff was that introduced by Sir Herbert Austin. In the Austin works every non-producer, from the shop labourer right up to the superintendent, share in the bonus, and when a man was employed he was given his rate plus a unit or a portion of a unit. For instance, the shop labourer would be the possessor of a quarter of a unit, the transport labourer would have half a unit, the storekeeper might have one unit, a man in charge or a foreman might have one and a half units, or if he had got on he might have two units, the assistant superintendent had three units, and there were a few of the senior superintendents who had five units. The value of the unit was arrived at by taking a percentage of the output of the works in money value. A certain percentage of the total output, *i.e.*, the amount which went on the books each week, was allocated to units, and the total number of units possessed by the staff was divided into that sum which gave a fixed value for the unit. Now the value of the unit could vary in two ways: it went up in proportion to the output from the works and went down in proportion to the number of men employed on non-productive labour. Thus it was to the advantage of every man in authority who had units to see that non-productive labour was kept down to a minimum. That, in

his opinion, was the finest system of bonus paid to non-productive labourers in existence. It worked splendidly in practice, the percentage being worked out with the idea of bringing the unit to something like the value of £1 per week under normal conditions.

Mr. Gordon England had also mentioned that in America the men even know the salaries of their chiefs and of the directors. In his opinion the fear of their mates was unknown to the American workers. If one man earned £15 per week and the man at his side earned only £7 that was his look out. The one took no notice of the other, and each man was enabled to work hard to live in fairly good conditions, to educate himself, and to rise. The fact that he knew the salaries of those above him and how they were earned, only acted as a great incentive to him to get closer to the man who earned them, and he would work and go all out to get to the same position himself. Over here things were quite different, and the idea of a man on the machine ever reaching the position at the top was one at which many of the chiefs of our firms still held up their hands in horror.

In so far as the introduction of the Ford system is concerned in an English works, he (Mr. Hutchinson) was very interested in that, and would like to watch developments. There appeared to be one thing that would have to be guarded against with scrupulous care—that was the employment of the Communist element. Unfortunately, these men worked very quietly and one very seldom heard of them. They got the other poor miserable beings with a bit of a voice talking for them. Generally speaking, they were good workers themselves and very often the last men one would believe to be Communists, until one came across the other type of Communist who was their dupe. These people must be guarded against if the system was to be a success, as such men deliberately did a tremendous amount of harm, not perhaps he thought because they believed it themselves, but because they were actuated by some mistaken idea that by doing their employers harm they did themselves good.

Mr. Oakley had mentioned that in many works there were members of the staff who did not do their best because they knew that were they to do so or not it would make no difference to the pay they received. He thought it must be a very badly organised concern where there were men on the staff who deliberately refrained from doing their best, although they drew their wages each week. He believed in paying members of the staff something as an incentive, but he was loathe to believe that in this country it was necessary to pay extra to get conscientious work from the majority of the members of the staff. He had a higher opinion of the men in this country than that.

Someone had suggested that he should lecture on this subject to

the trade unions and the employers. Curiously enough it had occurred to him at the time of writing the paper what an enormous amount of good could be obtained by merely putting the facts before all the parties concerned, so that the true factors could be understood by all. He had not attempted to deal fully with the subject, but he believed that if someone who was an authority on the matter could be induced to read a paper in various centres round the country a tremendous amount of good might be done.

Mr. Ferguson had mentioned the fact of the coppersmith who refused to bend a pipe or a template made by a toolmaker. Unfortunately, that was only too true, and it existed through all branches of the trade. An electrician on board a ship, for instance, could not put in or take out a wood screw until the carpenter arrived, and so it went on right through. There was no doubt about it that the workers' greatest enemy at the present time was the worker in another trade. One has just had a good illustration of it in the controversy over the steel houses. The people who were the most bigoted and unreasonable were of the very class to whom they should be of the greatest benefit.

MR. BASS proposed a hearty vote of thanks to the chairman, and said he felt he would like to record his appreciation of the able way in which the President had introduced the subject.

CORRESPONDENCE.

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Tool-room Lathes.

SIR,—Referring to the discussion in your March issue on Mr. Rawlings' paper, when a member remarked "that he had often wished for enlightenment why some big machine tool makers in this country had never produced a really sensitive tool room lathe," if the author of the above words would call at our works at Stratford he would probably get the enlightenment he calls for, although we do not claim to be one of the largest makers. For instance, there are at the moment twenty 13in. swing tool-room lathes on our floor. What is more, these are single friction pulley drive with ball bearing friction pulley and first shaft with back brake, all nickel-chrome gears running in oil.

Just recently we supplied sixteen 15in. swing similar machines to the Russian Government. These were fitted with one oiler, which supplied the oil for nearly all the quick change gear box, which cuts thirty-six direct pitches. The first tool-room lathes were built by us round about 1911 for the New Zealand Government, and we were, we believe, one of the first firms in the world to fit our machines as standard with a corrected lead screw.

HOLBROOK & SONS.

